AN COMPARATIVE STUDY ON SOIL STABILISATION USING LIME AND CEMENT

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Abstract— In this project an experimental study was conducted in the soil stabilization method by using the chemical admixtures like cement and lime. Stabilization is the process of physical and chemical alternation of soil to increase their engineering properties. And this process used to improving the load bearing capacity for the pavement works. In India expansive soil is popularly known as black Cotton soil. Compared to red soil the Black Cotton Soil is the problematic soil that has high potential for shrinking or swelling due to change of moisture content. Soils are stabilized with various proportion of chemicals (0%, 5%, 10%, and 15%) up to optimum percentage .And the properties are compared after done the following tests, Specific Gravity Test, Plastic Limit and Liquid Limit Test, California Bearing Ratio test. Unconfined compression test.

Keywords— soil stabilization1, cement2 , lime, Red soil3, Black cotton soil4, Specific Gravity Test5, Plastic Limit and Liquid Limit Test6, California Bearing Ratio test7, Unconfined compression test8.

1.INTRODUCTION

The soil stabilization is generally used for modify the engineering properties of the soil. Soil stabilization is broadly used in connection with road, pavement and foundation construction. It improves the engineering properties of the soil in terms of volume stability, strength, and durability. Soil stabilization occurs over a longer time period of curing. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger).

The other process is by improving gradation of particle size and further improvement can be achieved by adding binders to the weak soils, and the stabilization commonly done in several methods like chemical method, mechanical method, etc. Soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability The components of stabilization technology include soils and or soil minerals and stabilizing agent or binders.

1.1 Objective

1. To modify the engineering properties of the soil,
2. To improve the stiffness and the tensile strength of the soil,
3. To decrease the pavement thickness,
4. Improve durability and the resistance to the effect of the water,
5. Life of landfill is extended and natural resource is extended.

1.2 Scope of Our Project

- The scope of the study is used for finding the best pair of chemical to use it in the stabilization method by strength characteristics and compression characteristics.
- The soil stabilization will increase the soil properties.

1.3 Methodology

- Literature Collection And Study
- Material Collection And Study
- Sieve analysis
- Specific gravity test,
- Atterberg test,
- California bearing ratio test,
- Result And Discussions
- Conclusion

2. MATERIAL PROPERTIES

2.1 MATERIAL UESD

Black cotton soil
Red soil
Cement
Lime
Desired water

2.2 Black cotton soil

The black cotton soil is collected from Kadanthapatty, Namakkal (D.T), Tamil Nadu, India. In India deposition of Black cotton soil is very good and prosperous for farmers. All the basic amenities of life i.e. Food, clothes and house have been fulfilled by the soil, without soil It is just next to impossible to think about life on the earth. But on the other side in Civil Engineering aspects Black cotton soil is very troublesome and problematic and hazardous due to its characteristics. Because of its high swelling and shrinkage

characteristics, the black cotton soil has been a challenge to the Engineers. The black cotton soil is very hard when dry but loses its strength completely when in wet. The specific gravity of black cotton soil is 2.32. The plastic and liquid limit are 26.51% and 31.35%.

Fig 2.1 Black Cotton Soil

2.3 Red soil

Generally this soil visible in red color so it is also known as red soil. This kind of soil having the desired cohesiveness. And this soil is generally preferable for the agricultural purposes. It is suitable for growth the various crops. This soil is widely available in India so that we choosing it and taken for tests. The specific gravity of red soil is 3.75. The plastic and liquid limit are 25.2% and 31.6%.

Fig 2.2 Red soil

2.4 Cement

A cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete. The specific gravity of cement is 3.18 and its colour of cement is gray. The solubility of cement was 74gm/100ml of water.

2.5 Lime

Lime is calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/ or calcium hydroxide. It is also the name for calcium oxide which occurs as a product of coal seam fires and in altered limestone xenoliths in volcanic . The word lime originates with its earliest use as building mortar and has the sense of sticking or adhering.

Fig 2.3 Lime

2.6 Water

According to IS 3025, water to be used for mixing and curing should be free from injurious or deleterious materials. Portable Water is generally considered satisfactory. In the present investigation, available water within the campus is used for both mixing and curing purposes.

3. SOIL MIX PROPORTION

For the red soil and cement

1.SOIL + 0%CEMENT= SAMPLE 1
2.SOIL + 5% CEMENT= SAMPLE 2
3.SOIL + 10% CEMENT= SAMPLE 3
4.SOIL + 15%CEMENT=SAMPLE4

For the red soil and lime

1.SOIL + 0% LIME= SAMPLE 5
2.SOIL + 5% LIME= SAMPLE 6
3.SOIL + 10% LIME= SAMPLE 7
4. SOIL + 15% LIME= SAMPLE 8

For the block cotton soil and cement

1.SOIL + 0% CEMENT= SAMPLE 9
2.SOIL + 5% CEMENT = SAMPLE 10
3.SOIL + 10% CEMENT = SAMPLE 11
4. SOIL + 15% CEMENT= SAMPLE 12

For block cotton soil and lime

1.SOIL + 0% LIME = SAMPLE 13
2.SOIL + 5% LIME = SAMPLE 14
3.SOIL + 10% LIME = SAMPLE 15
4.SOIL + 15% LIME = SAMPLE 16

4. TESTING OF SAMPLES

4.1.Sieve Analysis Test

The sieve analysis is an important test to find the grain size of the soil. In this test the most finer sieve screen is 0.075 mm. The sieve sets are arranged in the order of IS code book provisions.

Fig 4.1 Sieve Machine

4.2 Specific gravity test

The specific gravity is a unique property to everything. But the value may change by their water absorption characteristics. And the specific gravity is tested with adding various chemicals with the soil by using the pycnometer and weighing balance.

For black cotton with cement and lime, specific gravity value.

Table 4.1 Specific gravity of Materials

S. NO	MATERIALS	0%	5%	10%	15%
1	Cement	2.325	2.42	2.82	2.69
2	Lime	2.325	2.51	2.73	2.55

4.3 Plastic limit and liquid limit test

This test is conducted to find the optimum moisture content taken by a soil to get the liquidity and the plasticity. The plasticity Index value find by subtracting the Liquid limit value with the Plastic Limit.

I_P = (Liquid limit) – (Plastic Limit) by using this formula we can say the condition of the soil.

The plasticity index test is done by IS 1498 codes.

Table 4.2 Plasticity Index for Black cotton and red Soil

S.NO	PLASTICITY INDEX	MATERIALS	0%	5%	10%	15%
1	Black cotton soil	Cement	4.84	4.92	3.98	5.54
2		Lime	4.84	4.260	3.78	4.17
1	Red soil	Cement	6.4	4.8	4.02	5.04
2		Lime	6.4	4.05	3.78	4.17

4.4 California bearing ratio

The California bearing ratio test is used to find the penetration stress. The CBR value is determined by the ration of test load to the standard load. The test procedure involves two parts, one is preparing the test specimen and another is penetration test. There is two type of compaction is used by two methods, 1. Static compaction, 2. Dynamic Compaction. The loading machine having the capacity of 5000kg of loading. The loading value is 1.25 mm per minute. In the CBR test , up to the 5mm penetration sample is taken to design. The CBR test is done by IS 2720 part 16, 1979.

Table 4.3 Soil Mixed with Cement

Cement(%)	CBR value(%)
0	4.88
5	6.51
10	6.90
15	7.56

Table 4.4 Soil Mixed with Lime

Lime(%)	CBR value(%)
0	4.88
5	6.89
10	7.03
15	7.89

5. RESULTS AND DISCUSSION

5.1 CBR TEST RESULTS

The CBR test is conducted on both two soils in two type of condition i) without Chemicals. ii) With chemicals in the following ranges 5%, 10%, 15%. And the test results are shown in the following figures.

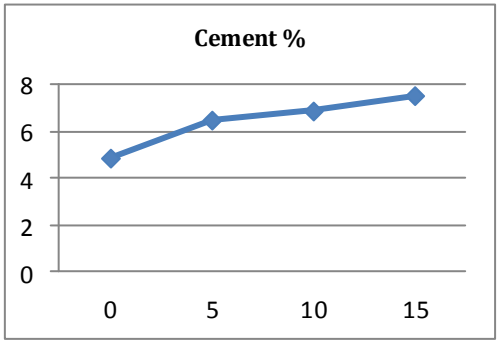

Fig 5.1 Soil mixed with Cement

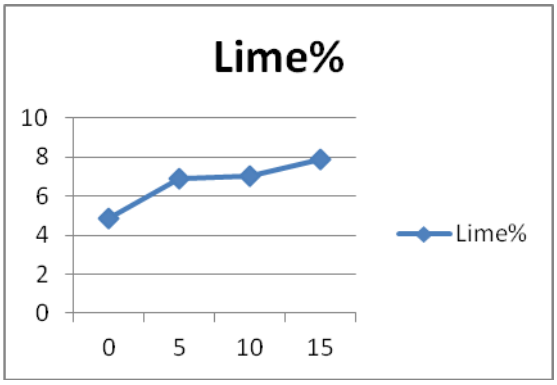

Fig 5.2 Soil mixed with Lime

6. CONCLUSIONS

The sieve analysis having same values compare to Materials adding. Because of the grain size of the pan value and the material value remain same. And the values are shown as graph in the fig 5.1 and fig 5.2

The Specific gravity test is conducted with the soil mix of materials such as cement and lime in the range of 0%, 5%, 10%, 15%. Compare to all the percentages the 10% is found as the optimum percentage. The values are return low range after reaching the 10%. The specific

Gravity Values of the Red soil and The Black cotton soil are shown in figure 5.3 and 5.4.

The Plasticity index values are finding by subtracting the liquid limit value and the plastic limit. And if the liquid limit increase means, the strength of the soil is reduced. By adding the materials, the Atterberg limit such as both the liquid limit and the plastic limits are reduced. The reduced level of I_P is shown in the fig.5.5 and fig. 5.6. By comparing the figures the optimum percentage is 10%. After the 10% the value is getting changes.

In the CBR test results, the values are gradually increased an 0%, 5%,10%, 15% by adding soil with cement and lime mix. The CBR test is generally based on the penetration values. In the red soil the sodium chloride mix raising the strength as high as the calcium chloride mix with the soil. And the Black cotton soil takes the sodium chloride to reach the strength higher.

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